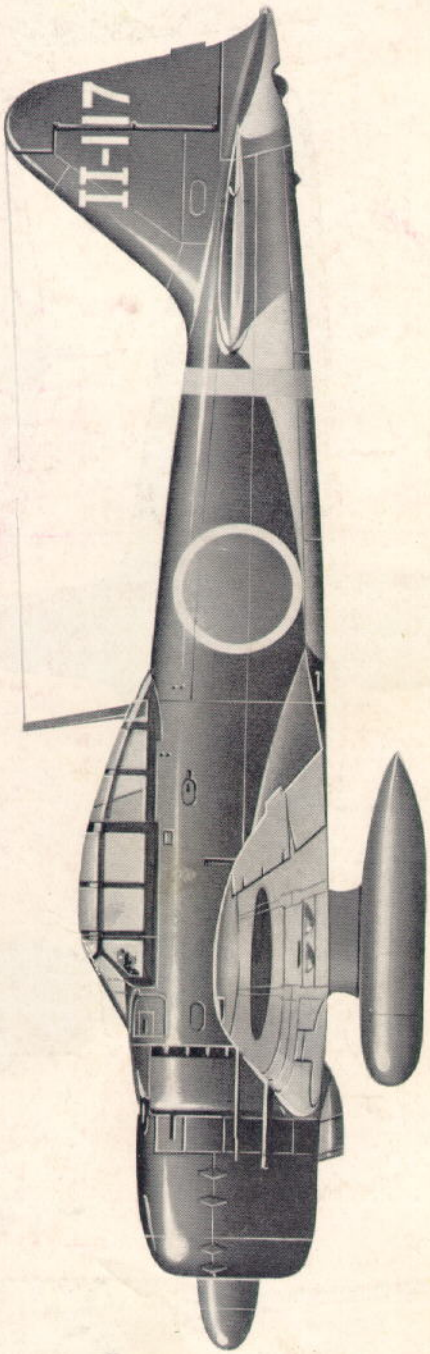
PROFILE
PUBLICATIONS

The Mitsubishi A6M3 Zero-Sen ("Hamp")



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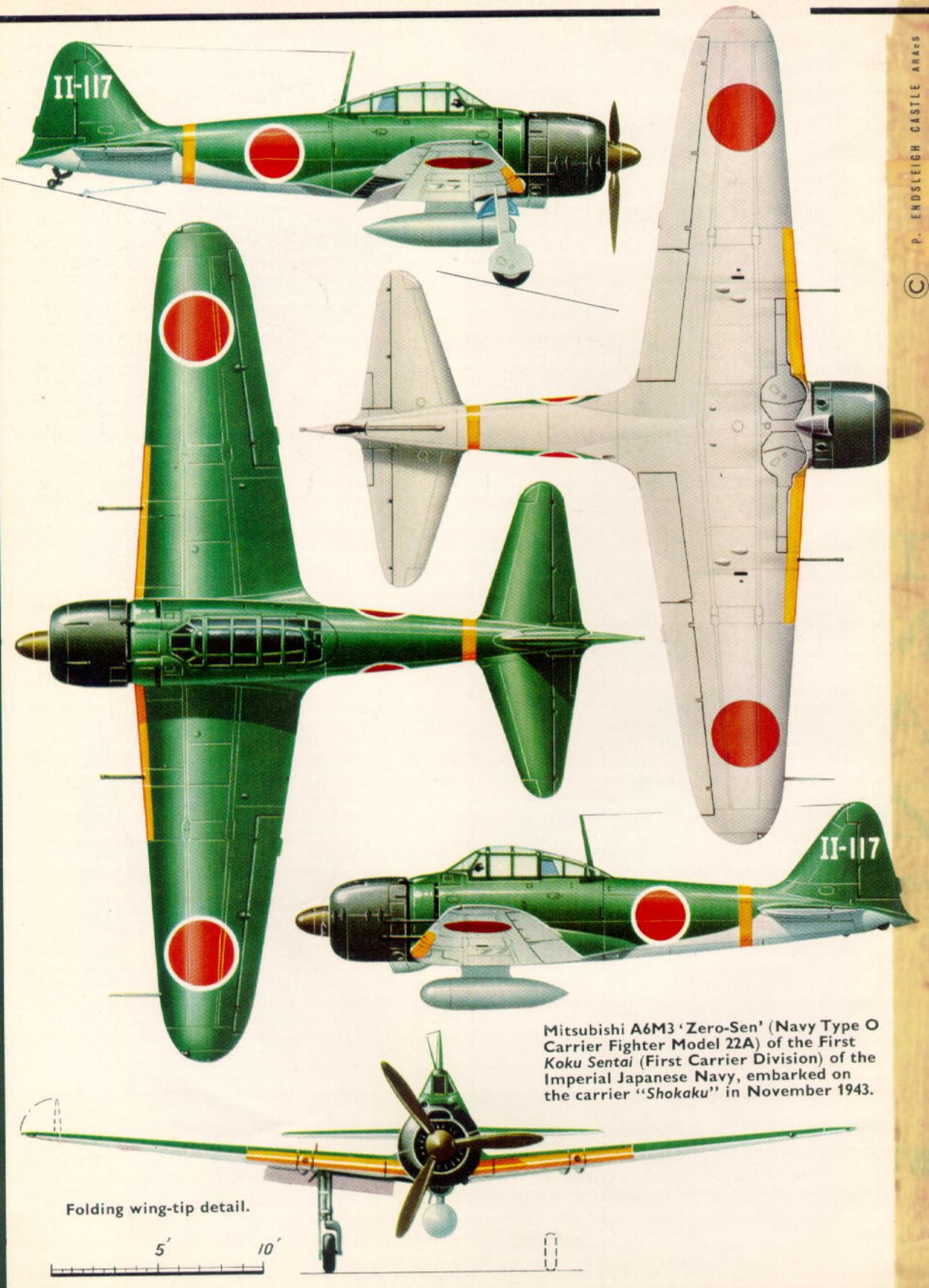

Mitsubishi A6M3 'Zero-Sen' (Navy Type O Carrier Fighter Model 22A) of the First *Koku Sentai* (First Carrier Division) of the Imperial Japanese Navy, embarked on the carrier "*Shokaku*" in November 1943.

Folding wing-tip detail.

5′ 10′

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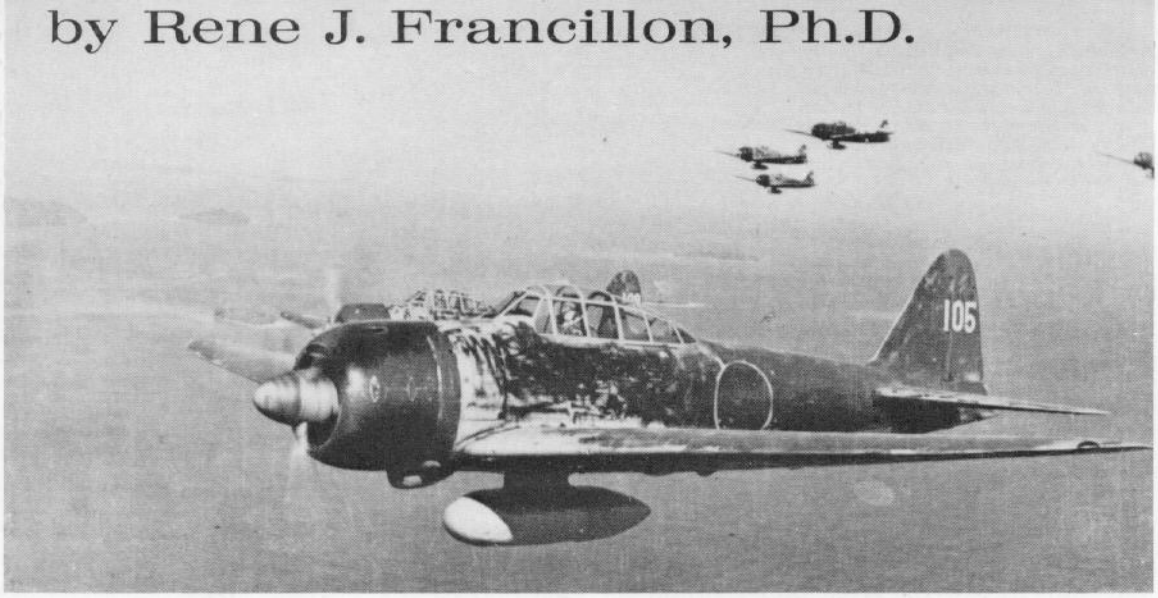
by Rene J. Francillon, Ph.D.

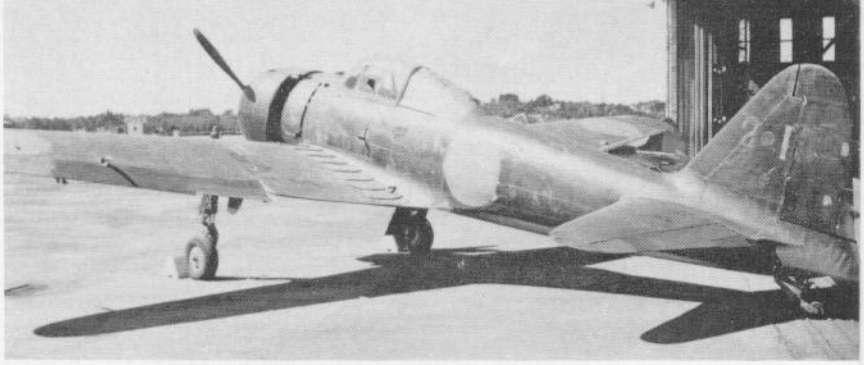


The Mitsubishi A6M3 Zero-Sen ("Hamp")

The excellent results obtained in China with the early versions of the *Reisen*, or Zero-Sen as the aircraft is better known outside Japan, exceeded the most sanguine hopes of the Imperial Japanese Navy (see *Profile* No. 129, "*The Mitsubishi A6M2 Zero-Sen*"). As the war against the Western Powers loomed closer both *Mitsubishi Jukogyo K.K.*, the manufacturers, and the Imperial Japanese Navy, the users, became concerned with the need to improve the aircraft to cope with the high performances of the aircraft the *Reisen* was anticipated to meet in combat. At this early stage no need was felt to improve either the high manoeuvrability of the aircraft, or its armament or even to provide some form of pilot and petrol tank protection and efforts were solely directed to improving level and climb speeds with the minimum number of modifications to avoid disrupting the production schedule. At that time *Nakajima Hikoki K.K.*, the manufacturers of the "Sakae 12" which powered the A6M2, had under development a more powerful version of this engine with two-speed, instead of single-speed, supercharger, and it was decided to use this engine on the proposed A6M3 model of the *Reisen*. Bench tests of the engine were satisfactory and it was placed in production at Nakajima's Musashi plant under the designation "Sakae 21" with a take-off rating of 1,130 h.p. at 2,750 r.p.m. and military ratings of 1,100 h.p. at 2,850 m. (9,350 ft.) and 980 h.p. at 6,000 m. (19,685 ft.).

The first A6M3 was completed in June 1941 and, except for a new cowling incorporating the supercharger air intake in its upper lip, was externally identical to the A6M2. The "Sakae 21" was driving a constant speed propeller with a diameter increased to 3·05 m. (10 ft. $0\frac{3}{8}$ in.) and, due to its larger size and weight, the fuselage petrol tank capacity had to be reduced from 98 litres (21·6 Imp. gallons) to 60 litres (13·2 Imp. gallons). Flight tests proceeded quickly and smoothly and soon afterward A6M3's were delivered to service units in Japan. Starting with the fourth aircraft the ammunition supply for the 20 mm. wing-mounted cannons was increased from 60 r.p.g. to 100 r.p.g. Flight evaluation had shown that performances were increased by the use of the more powerful "Sakae 21" but not as much as had been calculated. Furthermore, operational units were suggesting that the wing folding mechanism and aileron tab balance be removed to ease production and maintenance and increase manoeuvrability at high speed. As this modification was anticipated to also increase climb rate and maximum speed by some 3 km./h. (almost 2 m.p.h.) without adversely affecting manoeuvrability at low speed, the Imperial Japanese Navy instructed Mitsubishi to eliminate the folding wing tips, thus reducing span to 11 metres (36 ft. $1\frac{1}{16}$ in.), and to place the aircraft in production as the Navy Type O Carrier Fighter Model 32 (A6M3). A production order for this aircraft was also given to Nakajima and the A6M3 was soon met by the Allies in the New Guinea/Solomons theatre of operation. When first encountered the Navy Type O Carrier Fighter Model 32, because of its square-tipped wing, was mistakenly identified by the Allies as a new design. Consequently a new code name was allocated to the aircraft, the choice falling on "Hap" in honour of General H. Arnold, the U.S.A.A.F. Chief of Staff. The appearance of his nickname in barrack songs was not to the taste of General Arnold and the A6M3 Model 32 was promptly recoded "Hamp". Later, when the aircraft was at last identified as being merely a version of the "Zeke", the code

(Above) *A formation of A6M3 Model 22 fighters from the 251st* Kokutai *in flight over the Solomons. The unit code 'U1' on the fin has evidently been overpainted when the dark green camouflage pattern was applied over the original sky grey finish.* (Photo: Maru.)



A Model 22 of the 2nd Kokutai. *Note that the ailerons do not extend to the wingtip. This machine seems to have been fitted with a rudder similar to that of the A6M5, with an adjustable tab. (Unless otherwise indicated, photographs appearing in this Profile are supplied by the author.)*

name was again changed to "Zeke 32".

The combined effect of the reduction in fuselage petrol tank capacity and of the increased fuel consumption of the larger engine resulted in a reduction in range when compared to the A6M2. As range was a critical factor in the war in the Solomons, operational units soon began asking for a modified version of the aircraft with a range capability at least equal to that of the earlier version of the *Reisen*. After producing 343 Navy Type O Carrier Fighter Model 32 Mitsubishi switched to the Model 22, still carrying the short designation A6M3. The A6M3 Model 22 made use of the long wing of the A6M2 with manually folding wing tips modified to incorporate a 45 litre (9·9 Imp. gallons) capacity petrol tank outboard of the cannon bays between the two spars. With this modification the A6M3 Model 22 had the longest range of any *Reisen* and production by Mitsubishi totalled 560 machines to which should be added an unspecified number of aircraft built by Nakajima. At least three examples of this aircraft were fitted with wing-mounted experimental 30 mm. cannons and were tested operationally against Allied bombers at Rabaul. Late production aircraft were fitted with long barrel Type 99 Model 2 20 mm. cannons protruding from the wing leading edge, and were designated Model 22A.

THE A6M3 DESCRIBED

The Navy Type O Carrier Fighter Model 22 (Mitsubishi A6M3) was a single-seater, low-wing cantilever monoplane carrier- or land-based fighter of conventional all-metal stressed skin construction.

Fuselage: Semi-monocoque duralumin construction with light alloy (E.S.D. type), flush-riveted, stressed-skin covering built in two sections. The forward section, constructed as an integral part of the wing centre section, included the engine mounting, the fuselage petrol tank, the oil tank, the pilot's cockpit and a compartment aft of the cockpit where radio and other miscellaneous items of equipment were installed. The detachable rear section of the fuselage extended from a splice frame located just aft of the trailing edge of the wing and provided attachments for the tail surfaces, inflatable flotation bag, arrester hook and tail wheel. The vertical stabilizer was assembled as an integral part of the rear fuselage section. In addition a detachable tail cone was fitted.

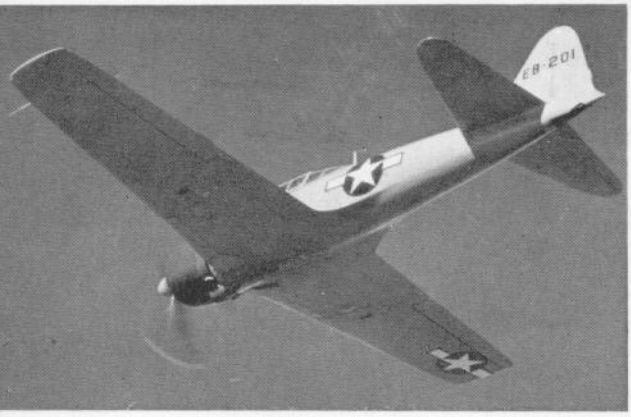
Wings: All-metal two-spar wings of high aspect ratio with pronounced taper, both in plan and thickness, to rounded tips. The aerofoil selected was the Mitsubishi No. 118 specially evolved from the long-proved B-9 and NACA 23012 series. At 30 per cent. of chord dihedral was 5° 40′ and the angle of incidence changed from 2° at the root to 0·5° at the tip. To prevent wing-tip stalls a "wash-out" was applied from the centre part of the wing toward the tip increasing gradually the camber near the wing-tips. Provisions were made in the wings for two 20 mm. cannons, four petrol tanks, two inflatable flotation bags, and main wheel wells. Metal split flaps with a width of 1·8 m. (5 ft. 11 in.) were situated between the ailerons and fillets. The fabric covered ailerons of smaller chord than the flaps were fitted with metal trim tabs adjustable on the ground only and large external balance weight. The pitot tube was mounted near the tip of the port wing. To ease handling and stowage aboard aircraft carriers 50 cm. (1 ft. 7$\frac{11}{16}$ in.) of each tip folded manually upward.

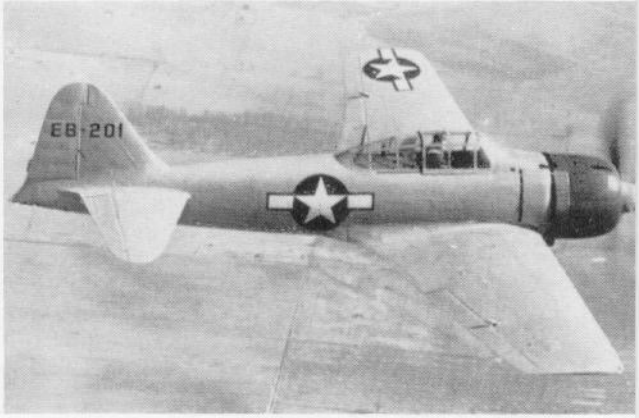
Tail: Except for the fabric covering of the rudder and elevators, the tail unit was entirely of metal construction. The vertical fin was integral with the rear section of the fuselage whilst the horizontal tail surfaces were attached above the centre of the fuselage. The rudder was fitted with a metal trim tab adjustable on the ground only whilst each elevator had a controllable trim tab.

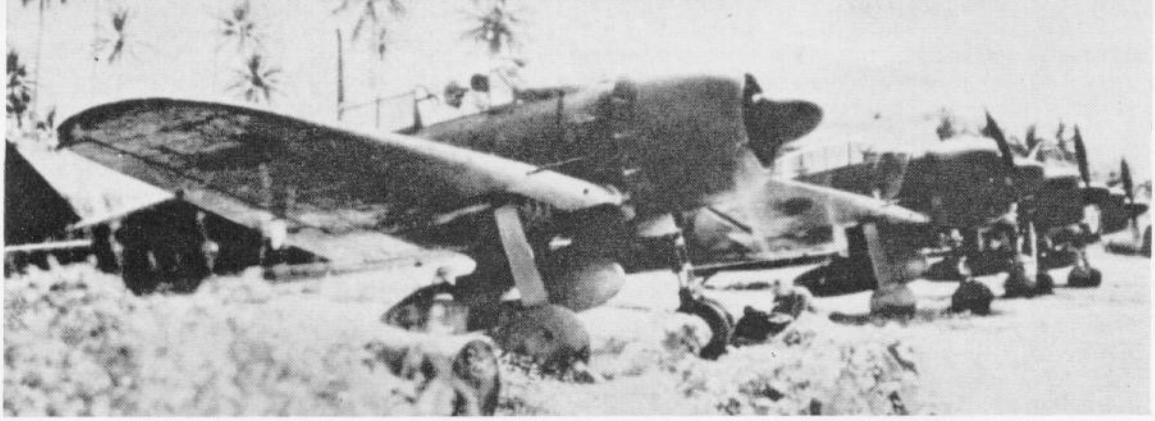
Undercarriage: The hydraulically-operated undercarriage was completely retractable. The main gear retracted inwards into wells forward of the front spar and when raised the gear was enclosed by fairing plates which fitted flush with the lower wing surfaces. The wheels were fitted with hydraulically-operated brakes. Although completely retractable into the tail

Model 22 fighters from the 2nd Koku Sentai *on a dusty airstrip at Rabaul during Operation* I-Go Sakusen, *Yamamoto's attempt to destroy Allied air power in the Solomons and Eastern New Guinea.*

The photographs on this page show various angles of a captured A6M3 during intensive evaluation trials by the U.S. Air Materiel Command at Wright Field, Ohio. The in-flight studies illustrate how sharply the plan view of the Model 32 differed from that of the Model 21, and explain perhaps why a different code name ("Hamp") was originally assigned to this "new" aircraft by Allied intelligence services. Note the flaps in the down position in the ground three-quarter rear view, and the intake in the upper cowling lip, another distinguishing feature between the A6M3 and A6M2. (Photos: U.S.A.F.)







A line-up of A6M3's at Buin during the Solomons campaign; the protruding Type 99 wing cannon identify these as Model 22A's.

cone, the tail wheel had no fairing doors and was fitted with a solid rubber tyre but was non-lockable and non-steerable. A retractable arrester hook which could be released by the pilot was carried beneath the rear section of the fuselage.

Cockpit: The pilot was strapped to his seat in three places and had all flight and engine controls within easy reach. The flight controls were conventional but a rudder bar was used instead of individual pedals. The trigger and gun selector switch were mounted on the throttle and an electric gunsight was fitted. The all-around-vision canopy provided excellent visibility in all directions, the only restriction being a narrow turn-over brace directly behind the pilot's head. For take-off and landing the pilot kept his canopy opened and raised his seat for better visibility.

Equipment: Type 96 Ku 1 H.F. transmitter and receiver of Japanese design with a transmitting range of 50 miles at 10,000 ft. The radio mast aft of the cockpit was a streamlined wood hollow with a copper wire inside. A Type 1 Ku 3 radio compass, a licence-built Fairchild set, with antenna loop located under the canopy just behind the turn-over brace was used. Two oxygen bottles were placed in the rear fuselage section. No armour on any part of the aircraft.

Armament: Two 7·7 mm. Type 97 synchronized machine guns with 500 r.p.g. on the upper decking of the front fuselage forward of the canopy with breeches protruding in the cockpit. Two 20 mm. Type 99 Model 1 Mark 4 (or Type 99 Model 2 Mark 3 on late production aircraft—Model 22A) cannons with 100 r.p.g. mounted in the wings outboard of the wheel wells. Underwing racks for two 60 kg. (132 lb.) or ten 32 kg. (70·5 lb.) bombs.

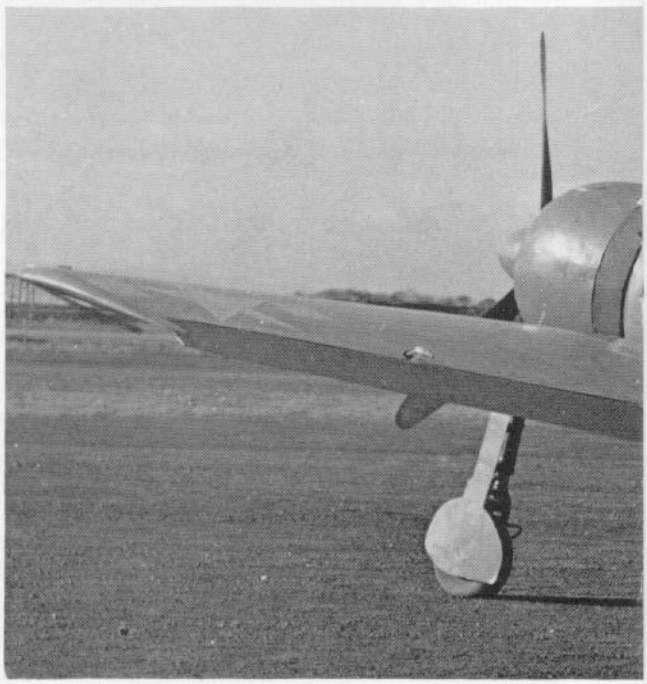
Powerplant: One 14-cylinder double-row radial air cooled Nakajima "Sakae 21" developing 1,130 h.p. at 2,750 r.p.m. on take-off, 1,100 h.p. at 2,850 m. (9,350 ft.) and 980 h.p. at 6,000 m. (19,685 ft.) and driving a 3·05 m. (10 ft. 0⅜ in.) three-blade, metal, constant-speed Sumitomo propeller. Two-speed supercharger with intake located in the upper lip of the cowling and oil cooler under the engine cowl flaps. Both the engine cowl flaps and oil cooler flaps were manually operated.

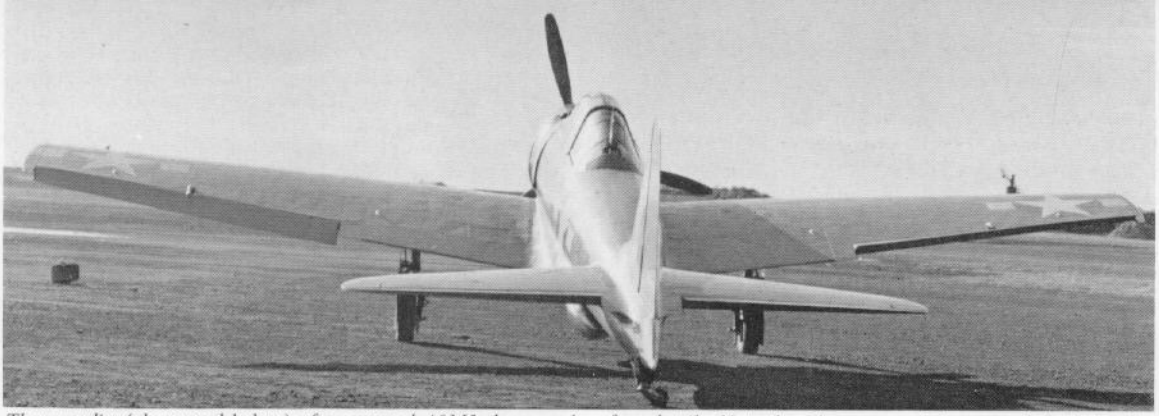
Fuel System: One 60-litre (13·2 Imp. gallons) unprotected fuselage petrol tank located between the oil tank and the instrument panel, two 210-litre (46·2 Imp. gallons) unprotected petrol tanks located in the wings between the two spars next to the wing roots and two 45-litre (9·9 Imp. gallons) unprotected petrol tanks located between the wing spars outboard of the cannons. One 330-litre (72·6 Imp. gallons) ventral drop tank built either of light alloy or plywood. A 91-octane fuel with about 6% lead added was standard. A 65-litre (14·3 Imp. gallons) oil tank was mounted in the forward fuselage.

THE WAR OF CONTAINMENT

Until the Battle of Midway and the attack on Dutch Harbour on 3rd and 4th June 1942, the Japanese expansion had run almost without interference from the Allies. However, Japan had over-stretched its forces and, when their hope of seeing the United States driven to the conference table failed to materialize, the Imperial Japanese Navy had only 492 *Reisens* to hold a front extending from Malaya to the Aleutians via the Dutch East Indies, New Guinea, the Solomon Islands, the Gilbert Islands, the Marshall Islands and the Chishima (Kurile) Islands. The Nipponese defeat at Midway had resulted in the loss of some 235 aircraft and their crews, then amongst the most experienced and better trained Japanese pilots, a situation from which the Imperial Japanese Navy would never recover.

On 2nd July 1942 the U.S. Joint Chiefs of Staff

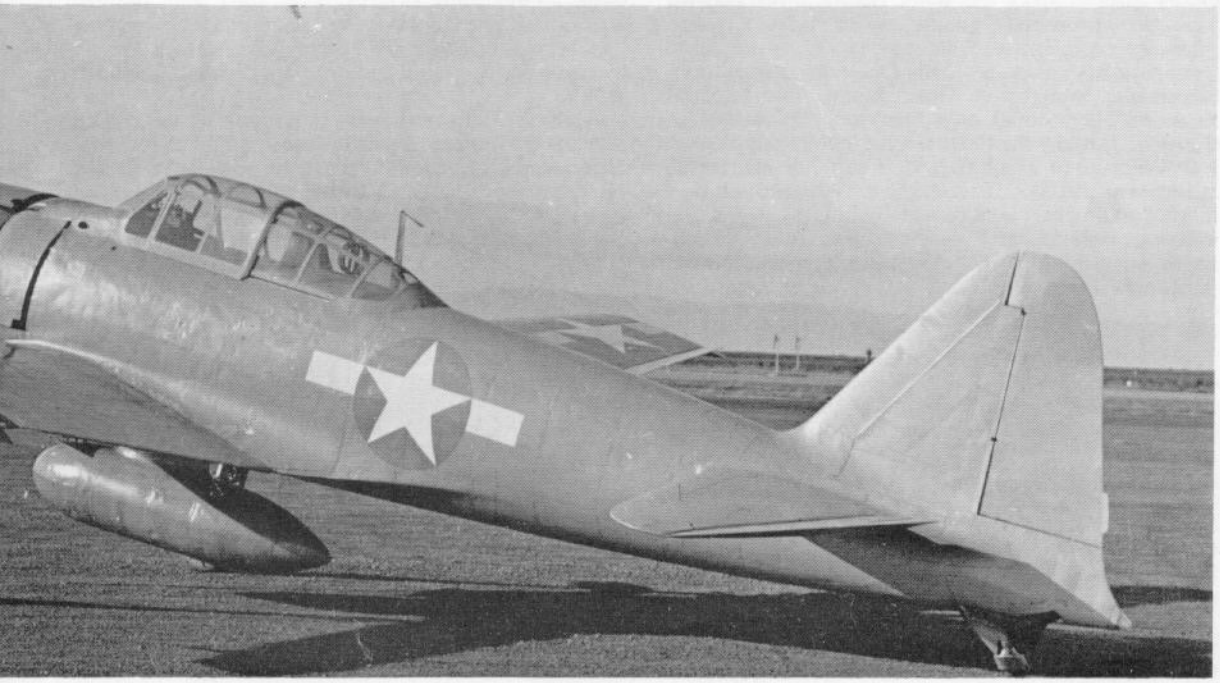




These studies (above and below) *of a captured A6M3 show good surface detail. Note the aileron mass balances and the light alloy ventral fuel tank; Japanese drop tanks were frequently constructed of treated plywood or wood/paper compound substances. The wrinkling of the upper wing skin evident on this machine must have had an adverse effect on the aircraft's performance.*

approved a plan put forward by Admiral King in which it was suggested that the forces under Vice-Admiral Ghormley, Commander South Pacific Area, should undertake the capture of Santa Cruz and Tulagi in the Solomon Islands rather than follow the advice of General MacArthur, Commander South-West Pacific Area, who wanted an attack on the Timor Islands. Thus began the first part of the arduous war to drive back the Japanese forces and defeat Japan.

The initial landings on Tulagi and Lunga Point on Guadalcanal took place on 7th August without air opposition from the Imperial Japanese Navy as aircraft of the U.S. Fifth Air Force had dropped 46,000 pounds of bombs over Rabaul and 150,000 pounds of bombs over the Japanese airfields at Lae and Salamaua in New Guinea. However, as related in *Profile* No. 129, the Imperial Japanese Navy mounted its first operation against the landing area in the afternoon of the 7th. The primary objective of the Allied operation was the capture of a landing field which the Japanese had under construction. After its capture this airfield, the famous Henderson Field, was completed by the "Seabees" and was ready to receive its first aircraft less than two weeks later when a squadron of F4F's and a squadron of SBD's, both belonging to the U.S. Marine Corps, began operations. For the next six months the American troops round Henderson Field held out against, and finally defeated, persistent Japanese attempts to drive them off the island; and a series of crucial sea and air battles were fought for Guadalcanal. Initially the Imperial Japanese Navy had at their disposal a small but efficient force of *Reisens* centred around the *Tainan Kokutai*, which mounted its operations from bases at Rabaul some 560 nautical miles from Guadalcanal. Faced by a determined opposition rapidly growing in strength, the *Reisens* were unable to obtain air superiority and their losses mounted rapidly. During the flight back to Rabaul many *Reisens* were running out of fuel and pilots were unable to bring back their damaged aircraft. However, two new airfields were completed by the Japanese at Buka and Buin on Bougainville Island but, due to poor weather hampering air operations, the *Reisens* failed to support a Japanese ground offensive.



Q-102, *a "Hamp" of the 2nd* Kokutai, *shortly after its capture by Australian troops at Buna, New Guinea on 2nd January 1943. The presentation inscription* Hokoku-872 *is clearly visible on the fuselage side.* (Photos: Australian War Memorial)

Despite the commitment of additional *Kokutais* the fighter strength of the Imperial Japanese Navy never reached a satisfactory level and as of 24th September the Japanese had available in this theatre the following *Reisen* units:

Tainan Kokutai	9 A6M2		
6th Kokutai	12 A6M2	and	13 A6M3
3rd Kokutai	20 A6M2		
Kanoya Kokutai	9 A6M2		
2nd Kokutai			16 A6M3
	50 A6M2	and	29 A6M3

Although the A6M3 Model 32 had proved a better fighter aircraft than the older A6M2, A6M3 losses were proportionately greater as its lack of range often forced it down at sea during the return flight from Guadalcanal. By 28th October, despite reinforcements brought in from Japan, the Imperial Japanese Navy could only muster thirty *Reisens* in the area. Initially the *Reisens* were mainly opposed by F4F Wildcats to which they were superior but, as the Allies increased their air strength at Guadalcanal, they met increasing numbers of equally inferior P-39's and P-40's as well as, later in the year, a small force of much superior P-38F's. The loss of experienced pilots was being felt increasingly but the fight over Guadalcanal dragged on another three months, the last Japanese troops abandoning the island on 7th February 1943. During the six month battle for Guadalcanal Japan lost 893 aircraft and 2,362 airmen in addition to 25,800 troops and two battleships, one carrier, four cruisers, eleven destroyers and six submarines totalling 134,000 tons. As Japanese aircraft production and crew training rate could barely keep up with the losses the defeat at Guadalcanal was indeed a staggering blow for Japan. It was then that the U.S. forces introduced a new type of fighter aircraft, the F4U Corsair, which decisively won control of the sky from the *Reisen*.

After the savage fight for Guadalcanal both sides were too weary to take the offensive. However, an attempt by the Japanese to reinforce their garrison at Lae resulted in a major defeat during the battle of Bismark Sea between 2nd and 4th March 1943 when the *Reisens* of the *253rd Kokutai* failed to give adequate air cover to a naval convoy consisting of seven transports and one special vessel escorted by eight destroyers, which carried 5,000 troops of the 51st Division, aircraft, spare parts, fuel and supplies to the Japanese bases on Huon Gulf. Spotted by a B-24 on 2nd March, the convoy was repeatedly attacked by Allied aircraft and P.T. boats during the next two days. Only four destroyers escaped and the ten *Reisens* which had attempted to protect the convoy had been shot down by P-38's. The Allies had only lost one B-17, one B-25, one Beaufighter and three P-38's.

Admiral Yamamoto was not a man to stay on such a defeat and, under his direct command, the Imperial Japanese Navy mounted in April 1943 an offensive operation coded *I-Go Sakusen* (Operation A) aimed at destroying Allied Air Power in the New Guinea/Solomons area. For this operation a force of 350 combat aircraft, smaller than that which had attacked Pearl Harbour but still larger than anything the Japanese had been able to throw into action in defence of Guadalcanal, was assembled by reinforcing the 190 aircraft of the *26th Koku Sentai* (Air Flotilla) (Rear Admiral Kozaka) and of the *21st Koku Sentai* (Air Flotilla) (Rear Adm. Ichimaru) with 160 aircraft disembarked from the carriers of the *1st Koku Sentai* (Carrier Division) (Vice-Adm. Ozawa) and of the *2nd Koku Sentai* (Carrier Division) (Vice-Adm. Kakuda). From 7th to 14th April Japanese bombers escorted by *Reisens* attacked a variety of targets in the Solomons and Eastern New Guinea. Japanese losses amounted to some fifty aircraft but they are believed to have shot down 134 Allied aircraft and destroyed others on the ground. This apparent success, not borne out by facts, led Adm. Yamamoto to call off the operation. However, Japanese losses

had been heavy enough to necessitate the return to Japan of the 1st Carrier Division and to permanently assign to land bases at Truck and Rabaul the surviving aircraft of the 2nd Carrier Division.

Before returning to his headquarters in Tokyo, Adm. Yamamoto decided to visit front-line units on Bougainville and Shortland Islands. On 18th April 1943, Adm. Yamamoto and seven of his staff officers boarded two Mitsubishi G6M1-L ("Betty") and, escorted by nine A6M3's, set off for Ballale airfield on Shortland Island. Unknown to the Japanese Command, the Allies had broken the enemy code and thus knew the estimated time of arrival at Ballale of Adm. Yamamoto. Sixteen P-38F's were sent to intercept the Japanese formation off Bougainville and, diving to the attack, they surprised the escorting A6M3's. Within minutes the two "Bettys" transporting Adm. Yamamoto and his staff and three A6M3's had been shot down, the U.S. fighters losing only one of their aircraft. Creditable performance of the U.S. Intelligence Service, good planning of the entire operation, pilots' skill and the inferiority of the A6M3, particularly under fast diving attack by P-38, all contributed to the loss of the ablest officer ever to command the *Rengo Kantai* (Combined Fleet).

REISEN vs. SPITFIRE

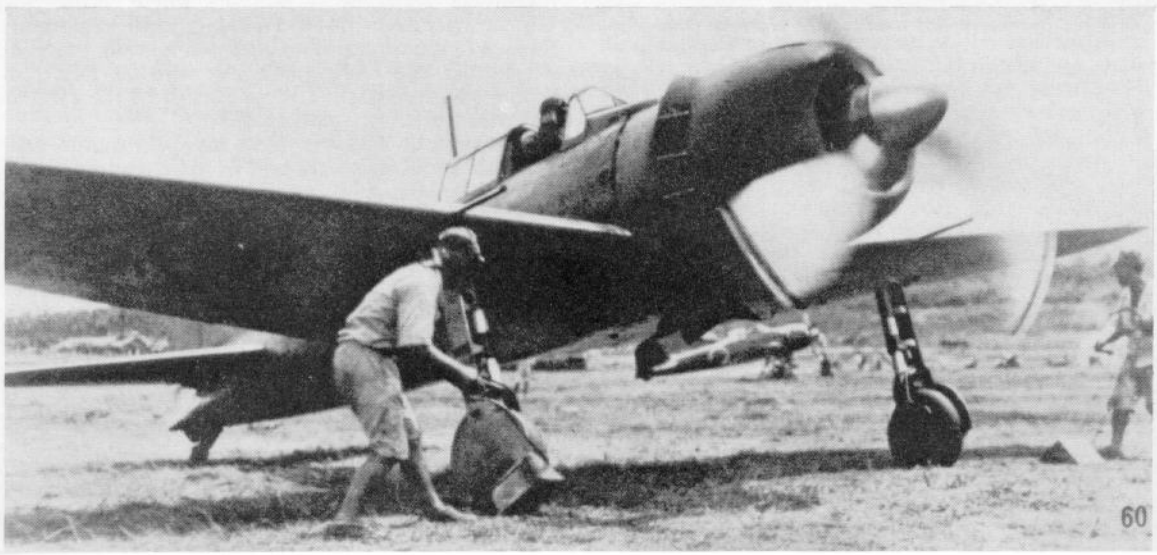
Although the A6M3's are best remembered for their participation in the war of attrition in the Solomons they also actively took part in the Imperial Japanese Navy operations directed against Australia's Northern and Western Territories and Queensland. The first attack against Darwin took place on 19th February 1942 when carrier-based aircraft, augmented by land-based attack bombers, sunk eight ships, damaged twelve others and destroyed twenty-three U.S. and Australian aircraft. Japanese attacks against Darwin and Horn Island continued intermittently until June 1944 and A6M3's replaced earlier A6M2's in late 1942 to provide fighter escort for the "Nells" and "Bettys". Initial operations were quite successful and A6M2's and A6M3's were engaged in armed reconnaissance as well as bomber escort missions. The installation of a radar chain by the R.A.A.F. and the arrival of Australian and American fighter units resulted in a sharp increase in Japanese losses. However, the Mitsubishi G3M's and G4M's and their escort of *Reisens* remained a nuisance and forced the Allies to retain in Australia a disproportionate number of badly needed aircraft. Australia sought Spitfires for the R.A.A.F. and obtained from the British Prime Minister the release of three Spitfire fighter squadrons, No. 54 R.A.F. and Nos. 452 and 457 R.A.A.F. under the command of Group Captain Walters and Wing Commander Caldwell. The Spitfires drew their first blood on 6th February 1943 when a lone Mitsubishi Ki-46 reconnaissance aircraft was shot down; the first major clash against the *Reisens*, on 15th March, occurred over Darwin, the Japanese losing seven aircraft but destroying four Spitfires. The experienced British and Australian pilots at first underestimated the *Reisens* and, used to the less manoeuvrable German fighters, attempted to dogfight with the nimbler A6M3's. Even the superlative Spitfire was no match for the *Reisen* in this type of combat but soon, under the efficient leadership of Wing Commander Clive Caldwell, the Spitfire pilots developed highly successful tactics and gained air supremacy over Australia. (See *Profile* No. 166, "*The Supermarine Spitfire V Series*".)

By the middle of 1943 the A6M3 was found inferior to most Allied aircraft but the Imperial Japanese Navy persisted in further development of the *Reisen*. The A6M5 soon entered service and *Reisens* of this type rapidly replaced the A6M3's. However, some of the older aircraft stayed in service and, on 7th January 1945, a single Navy Type O Carrier Fighter Model 32, the obsolete "Hamp" jumped a flight of four P-38's over Los Negros Island. The leader of the flight attempted to help one of his pilots who was being attacked by the *Reisen* and in so doing failed to follow three basic rules: (1) Never attempt combat at low altitude; (2) Never let your airspeed fall below 300 m.p.h. indicated; (3) Never keep your wing tanks in a fight. So died the second ranking U.S. fighter ace, Major Thomas B. McGuire.

THE REISEN EVALUATED

As related above, by 1943 the *Reisen* was no longer the formidable foe which had swept the sky over the Pacific when Japan first entered the war; but it was still a force to be reckoned with, as shown by the

Chocks away! A Model 22A runs up for take-off during the Solomons campaign. Heavy fighting in the area during the second week of April 1943 seemed at first to have yielded good results for the Japanese, but losses were heavy enough to necessitate the return of 1st Koku Sentai *to the Home Islands and the transfer of survivors of the 2nd* Koku Sentai *to land bases at Truk and Rabaul.*



recommendations made in a then-classified document prepared by the Intelligence Service, U.S. Army Air Forces, for distribution to operational squadrons.

"The Zero Fighter, because of its low wing loading, has superior manoeuvrability to all our present service type aircraft. It is necessary to maintain a speed over three hundred (300) miles per hour indicated to successfully combat this airplane. In developing tactics against the Zero, cognizance should be taken of two facts:

(1) Slow rate of roll of the Zero at high speeds.
(2) Inability of the Zero engine to continue operating under negative acceleration.

The engine performance of the Zero is superior to the present service type engine without turbo-superchargers. This superiority is recognizable in the fact that maximum manifold pressure can be maintained from sea level to sixteen-thousand (16,000) feet.

Recommendations: That all pilots entering the theater of operation where the Zero can be expected, be instructed in the following:

(1) Never attempt to dog fight the Zero.
(2) Never manoeuver with the Zero at speeds below three-hundred (300) miles per hour indicated unless directly behind it.
(3) Never follow a Zero in a climb at low speeds. Service type ships will stall out at the steep angle where the Zero has just reached its most manoeuvrable speed. At this point it is possible for the Zero to complete a loop putting it in a position for a rear quarter attack.

That airplanes to be used against the Zero be as light as possible and that all equipment not absolutely necessary for combat be removed".

The same report gave details of comparative flight trials of the Reisen and contemporary U.S. fighters and the relevant portions of this report are summarized to provide the reader with a better understanding of the conditions then prevailing.

Zero versus P-39D-1:

"In a formation take-off the P-39D-1 left the ground first and reached 5,000 feet just as the Zero was passing 4,000 feet. Up to 10,000 feet the P-39D-1 continued to climb faster and maintained its advantage until an altitude of 12,500 feet was reached. Above this altitude the Zero walked away from the P-39D-1, had caught up with the Airacobra at 14,800 feet and reached 25,000 feet approximately five minutes before it. In level flight the P-39D-1 was faster than the Zero up to 17,000 feet.

In combat at low altitude the P-39D-1 should take advantage of its higher climbing speed to break away but above 15,000 feet the best method is to dive at high speed and zoom back behind the Zero. Never attempt to follow the Zero in slow speed manoeuvers."

Zero versus P-38F:

"With the two aircraft taking off in formation, the Zero left the ground first and was about 300 feet in the air before the P-38F left the ground. In the climb the Zero gained five seconds over the P-38F between 0 and 5,000 feet, four seconds between 5,000 feet and 10,000 feet and maintained its advantage between 10,000 feet and 18,200 feet. Above this altitude the P-38F was superior to the Zero in all manoeuvers except slow speed turns.

A recommended manoeuver to shake off a pursuing Zero is a high speed turn reversed as the Zero is unable to follow the P-38F in its manoeuver during high speed dive. By maintaining his speed the P-38F pilot is able to out-manoeuver the Zero above 25,000 feet."

Zero versus F4F-4:

"The Zero is superior to the F4F-4 in speed and climb at all altitudes above 1,000 feet, and is superior in service ceiling and range. Close to sea level, with the F4F-4 in neutral blower, the two planes are equal in level speed. In dive the two planes are equal with the exception that the Zero's engine cuts out in push-overs. In view of the foregoing, the F4F-4 type in combat with the Zero is basically dependent on mutual support, internal protection, and pull-outs or turns at high speeds where minimum radius is limited by structural or physiological effects of acceleration. However advantage should be taken when possible, of the superiority of the F4F in push-overs or rolls at high speeds, or any combination of the two."

Zero versus F4U-1:

"The Zero is far inferior to the F4U-1 in level and diving speeds at all altitudes. It is inferior in climb at sea level and above 20,000 feet. Between 5,000 and 19,000 feet the Zero is slightly superior in average maximum rate of climb. This superiority becomes negligible at altitudes where carburettor air temperatures in the F4U are down to normal; close to the blower shift points it is more marked. However, the Zero cannot stay with the F4U-1 in high speed climbs. The superiority of the F4U at 30,000 feet is very marked.

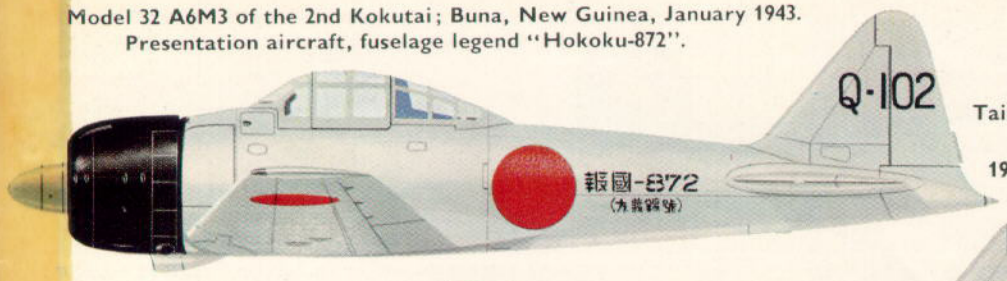
In combat with the Zero, the F4U should take advantage of its speed, and its ability to push-over and roll at high speeds if surprised. Due to its much higher wing loading, the F4U should avoid any attempt to turn with the Zero unless at high speed, and may expect the latter to outclimb him at moderate altitudes and low airspeeds. In this case the F4U should continue to climb at high airspeeds and on headings which will open the distance and prevent the Zero from reaching a favorable position for diving attack. After reaching 19,000-20,000 feet the F4U will have superior performance in climb and may choose its own position for attack".

From the information contained in this intelligence

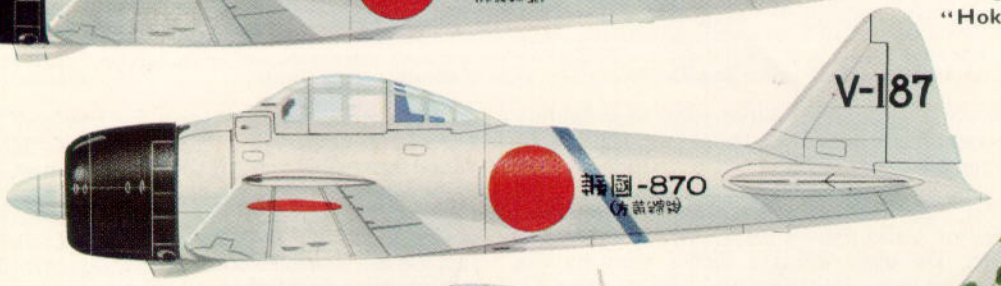
Cowling and propeller details of a disabled Model 32 Reisen *captured by Australian troops at Lae, New Guinea. For some reason the cowling of this machine has not been painted the customary black.* (Photo: Australian War Memorial)

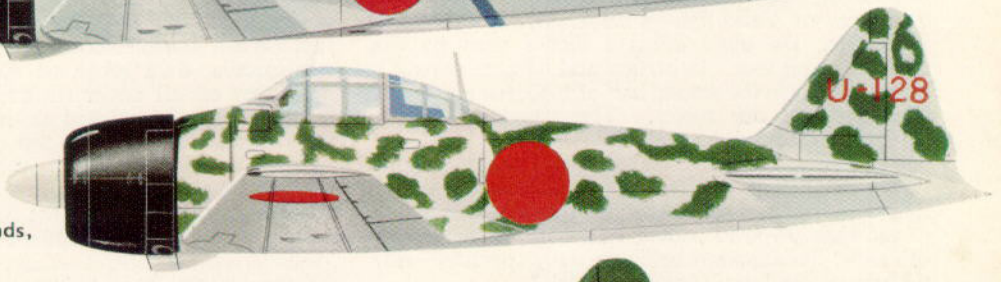
©WARD—

Model 32 A6M3 of the 2nd Kokutai; Buna, New Guinea, January 1943. Presentation aircraft, fuselage legend "Hokoku-872".

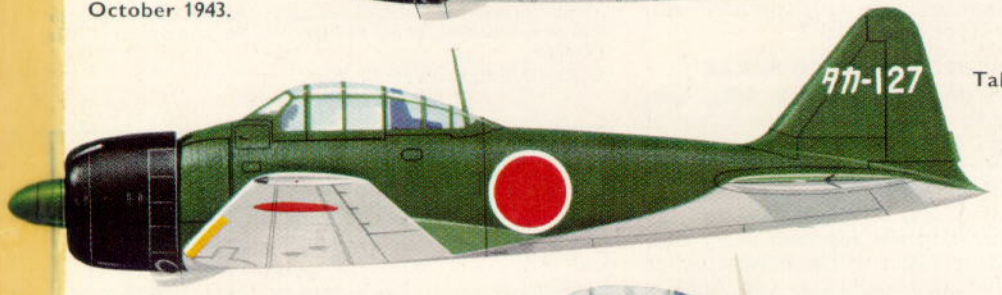


Model 32 A6M3 of the Tainan Kokutai; Salamaua, New Guinea, summer 1942. Presentation aircraft, fuselage legend "Hokoku-870".

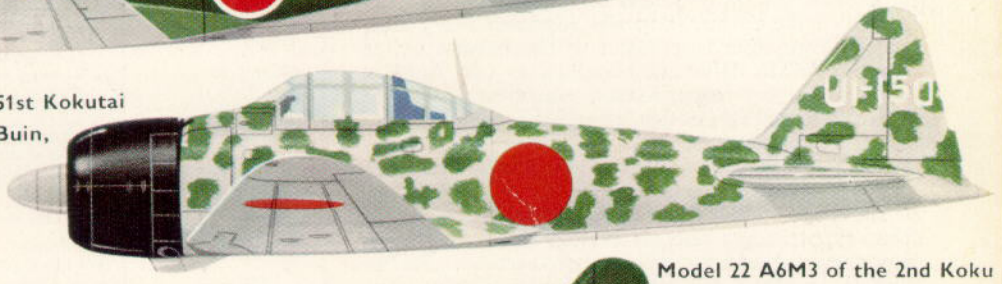




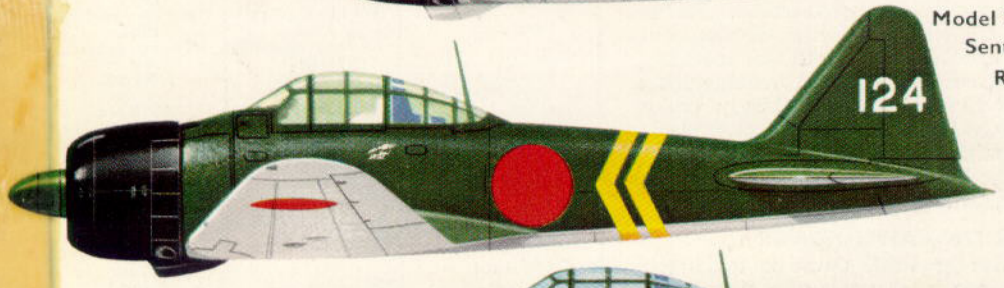
Model 32 A6M3 of the 6th Kokutai; Ballale, Solomon Islands, October 1943.



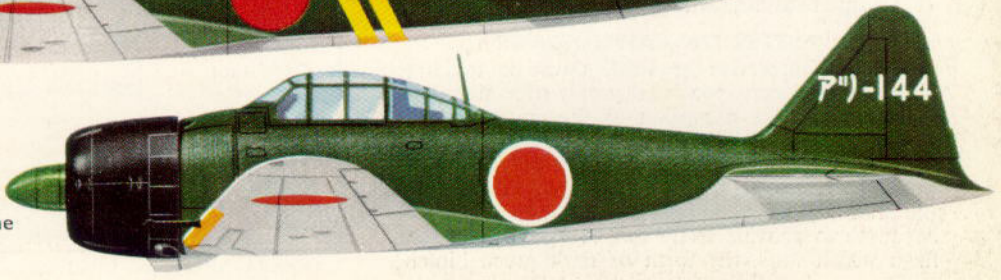
Model 32 A6M3 of the Takao Kokutai; Formosa, October 1943.



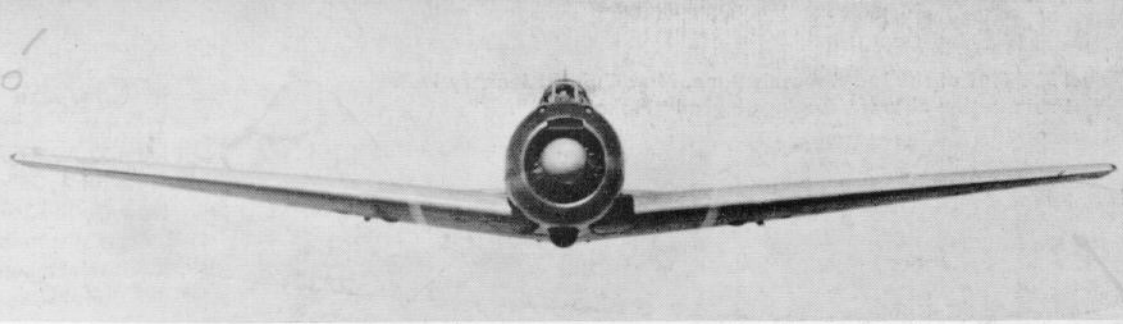
Model 22 A6M3 of the 251st Kokutai (ex-Tainan Kokutai); Buin, Bougainville, during winter 1942.



Model 22 A6M3 of the 2nd Koku Sentai (Carrier Division); Rabaul, summer 1943.



Model 22A A6M3 of the Atsugi Kokutai; Japan, January 1944.



The last sight many American, Australian and New Zealand airmen ever saw; although opposed by the inferior P-39, P-40 and F4F Wildcat, the A6M3 was finally driven from the skies by the advent of the superb F4U Corsair. (Photo: U.S.A.F.)

report it would appear that Allied pilots were fighting against tremendous odds but it should be remembered that some important factors were omitted in this report, namely the lack of armour protection and self-sealing petrol tanks in the *Reisen*, the superior armament of Allied fighters combined with adequate protection, the more efficient tactics used by the Allies ("finger four" formation and "Thach weave"), and, specially in the second half of 1943, the numerical superiority of our forces. The armament of the *Reisen* was found somewhat inadequate in fighter versus fighter combat as the 7·7 mm. machine guns had difficulty in penetrating the armour plate of Allied aircraft and the muzzle velocity and rate of fire of the early Type 99 Model 1 20 mm. cannons were too slow, the situation being partially corrected with the use of the later Type 99 Model 2.

THE TURBO-SUPERCHARGED SAKAE

The A6M4 version of the *Reisen* has long been conspicuously missing from the various historical studies yet published on this aircraft and even the designer of the *Reisen*, Mr. Jiro Horikoshi, could not remember what the A6M4 was! However, Mr. Horikoshi had the kindness to inquire amongst his friends of the former Imperial Japanese Navy and, recently, was able to confirm to the present writer that the A6M4 designation applied to two A6M2's fitted with an experimental turbo-supercharged Sakae engine. The design, modification and testing of these two prototypes was the responsibility of the *Dai-Ichi Kaigun Gijitsusho* (First Naval Air Technical Arsenal) at Yokosuka and took place in 1943. Lack of suitable alloys for use in the manufacture of the turbo-supercharger and its related ducting resulted in poor operation marred by numerous ruptures of the ducting, and fires. Consequently further development of the A6M4 was cancelled, the aircraft still providing useful data for future aircraft, and the manufacturing of the more conventional A6M5, already under development by *Mitsubishi Jukogyo K.K.*, was accelerated. This last-mentioned version of the *Reisen* will be the subject of the last *Profile* on this most famous of all Japanese aircraft.

NOTES ON CAMOUFLAGE

When entering service the A6M3's were painted in the then-standard non-specular sky-grey over all external surfaces with the exception of the engine cowling, which was black. The only other markings were the *Hinomarus* on the rear fuselage sides and four wing positions and the unit markings across both sides of the fin and rudder. It later became necessary for the Japanese to provide some sort of "ground" camouflage which took the form of dark green blotches applied on the aircraft upper surfaces and fuselage sides by ground crews. The extent of "blotching" varied from widely spaced spots to an almost uniform application of dark green. The need for such camouflage was recognized by the Imperial Japanese Navy which, on 3rd July 1943, issued an official order stating that *Reisens* issued to combat units be camouflaged in non-specular dark green on all upper surfaces and light grey on all under surfaces. A 75 mm. white border was to be painted around the *Hinomarus* on the fuselage sides and on top of the wings whilst a yellow identification band was to be painted on the leading edge of the wing. Although this form of camouflage was generally the rule until the Japanese surrender, numerous exceptions have been reported.

The author and publishers extend their grateful appreciation to Mr. Jiro Horikoshi for his assistance in the preparation of this Profile.

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SPECIFICATIONS

	A6M3 Model 22	A6M3 Model 32
Span	12·0 m. (39 ft. $4\frac{7}{16}$ in.)	11·0 m. (36 ft. $1\frac{1}{16}$ in.)
Length	9·06 m. (29 ft. $8\frac{1}{16}$ in.)	9·06 m. (29 ft. $8\frac{1}{16}$ in.)
Height	3·509 m. (11 ft. $6\frac{3}{32}$ in.)	3·509 m. (11 ft. $6\frac{3}{32}$ in.)
Wing Area	22·44 sq. m. (241·541 sq. ft.)	21·53 sq. m. (231·746 sq. ft.)
Empty Weight	1,863 kg. (4,107 lb.)	1,807 kg. (3,984 lb.)
Loaded Weight	2,679 kg. (5,906 lb.)	2,544 kg. (5,609 lb.)
Wing Loading*	119·4 kg./sq. m. (24·4 lb./sq. ft.)	118·1 kg./sq. m. (24·2 lb./sq. ft.)
Power Loading*	2·4 kg./h.p. (5·2 lb./h.p.)	2·3 kg./h.p. (5·0 lb./h.p.)
Fuel Capacity: Internal	570 l. (125·4 Imp. gallons)	480 l. (105·6 Imp. gallons)
Drop Tank	330 l. (72·6 Imp. gallons)	330 l. (72·6 Imp. gallons)
Engine:	Sakae 21	Sakae 21
Take-off rating	1,130 h.p.	1,130 h.p.
War Emergency rating	1,100 h.p. at 2,850 m. (1,100 h.p. at 9,350 ft.) 980 h.p. at 6,000 m. (980 h.p. at 19,685 ft.)	1,100 h.p. at 2,850 m. (1,100 h.p. at 9,350 ft.) 980 h.p. at 6,000 m. (980 h.p. at 19,685 ft.)
Maximum Speed	292 kt. at 6,000 m. (336 m.p.h. at 19,685 ft.)	294 kt. at 6,000 m. (338 m.p.h. at 19,685 ft.)
Cruise Speed	190 kt. (220 m.p.h.)	200 kt. (230 m.p.h.)
Climb to	—	6,000 m. (19,685 ft.)
in	—	7 min. 19 sec.
Range (Maximum)	—	1,284 naut. miles (1,477 st. miles)
Armament: Fixed	2×7·7 mm. Type 97 2×20 mm. Type 99	2×7·7 mm. Type 97 2×20 mm. Type 99
Bombs	2×60 kg. (132 lb.)	2×60 kg. (132 lb.)

* *At normal loaded weight and take-off rating.*

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